Please add new claim 18 as follows:

-- 18. A semiconductor device according to claim 17, wherein the adding element is contained in a concentration of 10 atom % or more. --

REMARKS:

Reconsideration and allowance of this application, as amended, is respectfully requested.

This amendment is in response to the Office Action dated November 20, 2002. Appreciation is expressed to the Examiner for the allowance of claim 16.

By the present amendment, the claims have been amended to clarify the invention.

Briefly, the present claims are directed to a feature of the invention which facilitates the use of noble metals as capacitor electrodes. Referring to Fig. 1, for example, a capacitor structure is shown using first and second electrodes 15 and 17 with a dielectric material 16, such as an oxide or a ferroelectric material, interposed therebetween. An insulating film 18 is in contact with the second capacitor electrode 17, while an insulating layer 12b is in contact with the first capacitor electrode 15.

As discussed on page 2, line 14 et seq., noble metals have the advantage of not being substantially oxidized at high temperature. Therefore, undesirable oxidation reactions are not likely to occur between capacitor electrodes made of noble metal and oxide films in contact therewith. However, a problem which has been discovered with using such noble metals is that they have poor adhesion to

materials such as silicon oxide which are typically used for insulating films (e.g. see page 3, line 7 et seq.). This can lead to a problem of adhesive fracture when the device is subjected to high temperature treatment.

In order to overcome this problem, one feature of the present invention is to add titanium or nickel to capacitor electrodes that contact oxide insulating films improve the adhesiveness (e.g. see page 35, line 21 et seq.). In accordance with one embodiment of the present invention, a preferred range for the added element of titanium and nickel is 10 atom % or more (e.g. page 8, line 3 et seq., page 20, lines 9-15 and 20-25 and page 26, lines 13-23). As noted on page 8, line 3 et seq.:

> "When the adding amount is over about 10 atom % (atomic percent), the adhesive fracture energy between the capacitor electrode and the silicon oxide film suddenly increases. . . .Thus, the adding amount of the adding element is preferably about 10 atom % to about 25 atom %."

Reconsideration and removal of the rejection of claims 1-6, 14 and 17 under 35 U.S.C. 112, first paragraph, set forth in paragraph 3 of the Office Action and 35 U.S.C. 112, second paragraph, set forth in paragraphs 7 and 8 of the Office Action is respectfully requested. As recognized by the Examiner, there is support in the specification for both the first capacitor electrode and the second capacitor electrode being in contact with an insulating film. For example, referring to Fig. 1, the insulating film 18 is in contact with the second capacitor electrode 17 while the insulating film 12b is in contact with the first capacitor electrode 15. However, as also recognized in the Office Action, there is not an illustrated embodiment which discloses a single insulating film which is in contact with both the first and second capacitor electrodes.

Accordingly, for purposes of clarification, each of claims 1, 2, 3, 4, 5, 14 and

17 has been amended to define that the insulating film is in contact with the first capacitor electrode or the second capacitor electrode, and further amended to define that the first or second capacitor electrode which is in contact with the insulating film contains a main constituting element from the listed group. As such, this now clearly reads on the embodiments of the invention, including Fig. 1, since the claim only requires the insulating film to be in contact with one or the other of the capacitor electrodes. Thus, this could be read on the insulating film 18 in Fig. 1 being in contact with the second capacitor electrode 17 or on the insulating film 12b being in contact with the first capacitor electrode 15. As such, it is respectfully submitted that clear support is now provided in the specification and drawings for the claim language, and reconsideration and removal of both the 35 U.S.C. 112, first paragraph and second paragraph rejections is respectfully requested.

Reconsideration and removal of the rejection of claim 15 under 35 U.S.C. 112, first paragraph set forth in paragraphs 4 and 5 of the Office Action, and the rejection of claim 15 under 35 U.S.C. 112, second paragraph, set forth in paragraph 9 of the Office Action is also respectfully requested. With regard to the points raised in paragraphs 4 and 9, claim 15 has also been amended to clarify that the insulating film is formed for insulating one or the other of the first or second capacitor electrodes. As noted above, this is clearly supported by the specification and drawings, for example, Fig. 1. With regard to the rejection set forth in paragraph 5 of the Office Action, it is noted that support for an electroconductive film being formed between an insulating film and a first capacitor electrode is set forth on page 36, line 7 et seq. with regard to Example 3 and Fig. 18, and page 37, line 8 et seq. In particular, an electroconductive film is shown as a sticking layer 26 formed between the insulating film 12b and the first capacitor electrode 15. As for forming

such an electroconductive film with the second capacitor electrode, page 37, lines 8-13 of the specification set forth:

> "In this Example, the electroconductive film (sticking layer 26) is formed only as to the first capacitor electrode 15. But, it is also possible to form the electroconductive film as to the second capacitor electrode 17 between the insulating film 18 and the second capacitor electrode 17."

As such, clear support is provided in the specification for forming an electroconductive film between an insulating film and either the first or second capacitor electrodes. Therefore, reconsideration and removal of the 35 U.S.C. 112, first paragraph, rejection set forth in paragraph 5 of the Office Action is also respectfully requested.

Finally, reconsideration and removal of the 35 U.S.C. 102(b) rejection of claims 1-3 and 14 as being anticipated by Horikawa (USP 6,015,989) is also respectfully requested. By the present amendment, each of these claims has been amended to specify that the adding element of titanium or nickel is in an amount of 10 atom % or greater. As discussed above, clear support can be found for this feature on pages 8, 20 and 26 of the specification.

Horikawa, on the other hand, teaches a very different concentration. Specifically, as can be appreciated from Fig. 12 and column 10, line 13 et seq. of Horikawa, the amount of titanium used by Horikawa is 0.1 to 5 atom % (see also claim 6 of Horikawa).

The reason for this low concentration is discussed in Horikawa with regard to Fig. 13 (e.g. see column 10, lines 16-58). As specifically noted in column 10, line 41 et seq.:

> "When the titanium content further increases to a value higher than 5% or more, the contact resistance increases. This appears to have resulted from the fact that titanium

> added excessively precipitates to form an oxide at a junction between an upper end of the connecting member 111 and the lower capacitor electrode 130 to thereby reduce the conductivity between the lower capacitor electrode 130 and the connecting member 111. The formation of the silicide by the reaction between the ruthenium and the Si in the connecting member (plug) 111 can be controlled, without the oxide of titanium being precipitated, by allowing the ruthenium thin-film, which eventually form the lower capacitor electrode 130, to contain titanium in a quantity of 0.1 to 5% by atom to thereby prevent deformation of the lower capacitor electrode."

Thus, clearly, Horikawa teaches directly away from the claimed feature set forth in claims 1-3 and 14 of adding nickel or titanium as an adding element in an amount of 10 atom % or more to a capacitor electrode formed of a noble metal. Accordingly, reconsideration and allowance of claims 1-3 and 14 over Horikawa is respectfully requested.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

If the Examiner believes that there are any other points which may be clarified or otherwise disposed of, either by telephone discussion or by personal interview, the Examiner is invited to contact applicants' undersigned attorney at the number indicated below.

To the extent necessary, the applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the

filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, Deposit Account No. 01-2135 (500.39830X00).

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By _____
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Registration No. 28,141

GEM/kd
703/312-6600

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claims 1, 2, 3-5, 14, 15 and 17 have been amended as follows:

1. (Amended) A semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the substrate, an oxide film formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, said first capacitor electrode or said second capacitor electrode which is in contact with the insulating film containing as a main constituting element at least one element selected from the group consisting of rhodium, ruthenium, iridium, osmium, and platinum, and as an adding element at least one element selected from the group consisting of nickel and titanium in an amount of 10 atom % or more.

2. (Amended) A semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the substrate, an oxide film formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, said first capacitor electrode or said second capacitor electrode which is in contact with the insulating film containing as a main constituting element ruthenium, and as an adding element at least one element selected from the group consisting of nickel and titanium in an amount of 10 atom % or more.

3. (Amended) A semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the substrate, an oxide film formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, said first capacitor electrode or said second capacitor electrode which is in contact with the insulating film containing as a main constituting element ruthenium, and as an adding element titanium in an amount of 10 atom % or more.

4. (Amended) A semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the substrate, an oxide film formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, said first capacitor electrode or said second capacitor electrode which is in contact with the insulating film containing as a main constituting element ruthenium, and as an adding element nickel.

5. (Amended) A semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the substrate, an oxide film formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, said first capacitor electrode or said second capacitor electrode which is in contact with the insulating film containing as a main constituting material at least one material selected from ruthenium oxide and iridium oxide, and as an adding element at least one element

selected from the group consisting of palladium, nickel, cobalt, and titanium.

14. (Amended) A process for producing a semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the substrate, an oxide film for a dielectric formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, which comprises forming [at least one of] the first capacitor electrode [and] or the second capacitor electrode which is in contact with the insulating film by using

(a) at least one element selected from the group consisting of rhodium, ruthenium, iridium, osmium and platinum as a main constituting element, or

(b) at least one material selected from the group consisting of ruthenium oxide and iridium oxide as a main constituting material, and at least one element selected from the group consisting of nickel and titanium as an adding element in an amount of 10 atom % or more.

15. (Amended) A process for producing a semiconductor device equipped with a capacitor for storing information comprising an oxide film formed between a first capacitor electrode and a second capacitor electrode, and an insulating film containing silicon as a main constituting element being formed for insulating one of the first capacitor electrode [and] or the second capacitor electrode, which comprises

forming an electroconductive film containing as a main constituting element at least one element selected from the group consisting of palladium, nickel, cobalt and titanium between said one of the first capacitor electrode or the second capacitor electrode and the insulating film.

17. (Amended) A semiconductor device equipped with a capacitor for storing information comprising a substrate, a first capacitor electrode formed on the

substrate, an oxide film formed in contact with the first capacitor electrode, a second capacitor electrode formed in contact with the oxide film, and an insulating film containing silicon as a main constituting element and formed in contact with the first capacitor electrode [and] or the second capacitor electrode, said first capacitor electrode or said second capacitor electrode which is in contact with the insulating film containing as a main constituting element at least one element selected from the group consisting of rhodium, ruthenium, iridium, osmium, and platinum, and means for enhancing adhesiveness of said first or said second capacitor electrode to said insulating film to prevent peeling comprising providing as an adding element to said first or second capacitor electrode at least one element selected from the group consisting of nickel and titanium. –

New claim 18 has been added.